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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE APPLICATION OF:

MICHAEL CHARLES GRADY

CASE NO.: FA1106USNA

APPLICATION NO.: 10/617,270

GROUP ART UNIT: 1711

FILED: JULY 10, 2003

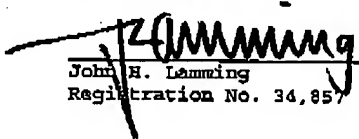
EXAMINER: OLGA ASINOVSKY

FOR: PRESSURIZED HIGH TEMPERATURE POLYMERIZATION PROCESS AND
POLYMERIZATION SYSTEM USED THEREIN

CERTIFICATE OF FACSIMILE TRANSMISSION

DATE: October 5, 2007

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AMENDED APPEAL BRIEF
37 C.F.R. §41.37(d)

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P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Responsive to the Order Remanding to the Examiner decided on August 28, 2007 and the Notification of Non-Compliant Appeal Brief mailed on October 2, 2007 as to the above-referenced application, a Notice of Appeal having been filed on August 25, 2005, Appellant submits the following Amended Appeal Brief. Pursuant to the Order and the Notification, Section 4 of this Amended Brief (Status of Amendments) and Section 8 (Claims Appendix), are amended to present those corrections necessary to bring the brief into compliance with 37 C.F.R. § 41.37 as required by the Order and Notification.

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1. REAL PARTY IN INTEREST

The application is assigned to E.I. du Pont de Nemours and Company, Barley Mill Plaza 25, Legal Patents, Wilmington, Delaware 19880-0025, said assignment being recorded at reel 013967, frame 0925 on September 12, 2003.

2. RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any related appeals or interferences.

3. STATUS OF CLAIMS

Of claims 1-64 in the application, claims 47-64 were withdrawn from consideration pursuant to Appellant's election of species made in response to the Examiner's restriction requirement without traverse and claims 1-46 remain pending in the application, all of which stand finally rejected.

Claims 1-3, 5-8, 10-12, 16-21, 24-33, and 36-46 stand rejected under 35 U.S.C. §102(b) as being anticipated by Prentice et al. (U.S. Patent No. 5,171,768).

Claims 1-46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Berge et al. (U.S. Patent No. 5,362,826) in view of Prentice et al. (U.S. Patent No. 5,171,768).

The final rejection of claims 1-46 is being appealed herein.

A copy of the pending claims is set forth in the Appendix hereto.

4. STATUS OF AMENDMENTS

The Amendment of April 12, 2005, as augmented by Appellant's Response to Notice of Non-Compliant Amendment dated May 4, 2005, has been entered.

The Amendment after final rejection of August 25, 2005 has not been entered.

5. SUMMARY OF THE CLAIMED SUBJECT MATTER

In one embodiment, the invention is directed to a process for producing a polymer comprising conveying hybrid reactor mixtures which are comprised of one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors that are maintained at effective hybrid reactor polymerization temperatures and sub-reflux polymerization gage pressures to polymerize a portion of the hybrid reactor monomers into the polymer and conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux polymerization gage

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pressures to polymerize the remaining portion of the hybrid reactor monomers into the polymer. (Claim 1; specification, page 2, lines 24-32; page 4, lines 8-13; page 6, lines 14-19; page 7, lines 5-19; page 10, lines 27-31; page 12, lines 10-25; page 15, line 28 to page 16, line 18; page 17, lines 2-7; page 19, line 28 to page 20, line 6; Examples, Comparative Copolymer 1 on page 24 through Copolymer 7, ending on page 35, line 3).

In another embodiment, the invention is directed to a process for producing a polymer comprising conveying a hybrid reactor mixture which is comprised of one or more hybrid reactor monomers and one or more hybrid reactor initiators to a hybrid reactor that is maintained at effective hybrid reactor polymerization temperature and sub-reflux polymerization gage pressure to polymerize a substantial amount of the hybrid reactor monomers into the polymer and conveying hybrid reactor contents to a batch reactor maintained at effective batch polymerization temperature and reflux polymerization gage pressure to polymerize the remaining amount of the hybrid reactor monomers into the polymer. (Claim 32; specification, page 2, lines 24-32; page 4, lines 8-13; page 6, lines 14-19; page 7, lines 5-19; page 10, lines 27-31; page 12, lines 9-25; page 15, line 28 to page 16, line 18; page 17, lines 2-7; page 19, line 28 to page 20, line 6; Examples, Comparative Copolymer 1 on page 24 through Copolymer 7, ending on page 35, line 3.)

In a third embodiment, the invention is directed to a process for producing a graft copolymer comprising conveying hybrid reactor mixtures which are comprised of one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors that are maintained at effective hybrid polymerization temperatures and sub-reflux polymerization gage pressures to polymerize the hybrid monomers into macromonomers, conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux polymerization gage pressures, and conveying batch reaction mixtures which are comprised of one or more batch reactor monomers and one or more batch reactor initiators to polymerize the batch reactor monomers into backbones of the graft copolymer having the macromonomers grafted onto the backbones. (Claim 33; specification, page 3, lines 1-15; page 4, line 23, to page 5, line 2; page 20, line 7 to page 22, line 6; Examples, Macromonomer 1, page 35, through Graft Copolymer, ending on page 37, line 29.)

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In a further embodiment, the invention is directed to a process for producing a polymer blend comprising conveying hybrid reactor mixtures which are comprised of one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors that are maintained at effective hybrid polymerization temperatures and sub-reflux polymerization gage pressures to polymerize the hybrid monomers into a hybrid reactor polymer, conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux pressures, and conveying batch reactor mixtures which are comprised of one or more batch reactor monomers and one or more batch reactor initiators to polymerize the batch reactor monomers into a reactor polymer to form the polymer blend. (Claim 46; specification, page 22, lines 7-21.)

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

- I. Whether claims 1-3, 5-8, 10-12, 16-21, 24-33, and 36-46 are anticipated under 35 U.S.C. §102(b) by Prentice, et al., U.S. Patent No. 5,171,768 (hereafter "Prentice").
- II. Whether claims 1-46 are unpatentable under 35 U.S.C. §103(a) over Berge, U.S. Patent No. 5,362,826 (hereafter "Berge") in view of Prentice.

7. ARGUMENT

I. Whether Claims 1-3, 5-8, 10-12, 16-21, 24-33, and 36-46 Are Anticipated Under 35 U.S.C. §102(b) by Prentice.

Claims 1-3, 5-8, 10-12, 16-21, 24-33, and 36-46 stand rejected under 35 U.S.C. §102(b) as being anticipated by Prentice.

Prentice discloses a free radical emulsion polymerization process for producing a latex composition. The process comprises (i) initially polymerizing non-carboxylic comonomers in the presence of carboxylic monomers to yield 3% to 12% polymer product, and then (ii) copolymerizing a conjugated diene with the unreacted non-carboxylic comonomer from step (i) in the partially polymerized latex from step (i) (Col. 1, lines 47-54). The Prentice process requires at least one conjugated diene, at least one non-carboxylic vinyl aromatic or aliphatic comonomer, at least one ethylenically unsaturated carboxylic acid monomer (Col. 1, lines 35-47), water, chain transfer agents, non-

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polymerizable substituents such as electrolytes or chelating agents, emulsifiers, and initiators. (Col. 1, line 63 to Col. 2, line 4). While the Prentice process embodies two stages, it is crucial to understand each stage and the particular function it serves in Prentice. The first stage is "pre-polymerization" (Col. 1, line 27) in heterogeneous medium to form an emulsion of the low concentration of latex formed in this step by conversion of a small amount of the vinyl monomer. Thus, non-carboxylic comonomers are polymerized in the presence of unsaturated carboxylic acid monomers to a conversion of 3% to 12% to form a partially polymerized latex. In the second stage, the conjugated diene primary monomer is copolymerized with the unreacted non-carboxylic comonomer from the first stage in the presence of the partially polymerized latex from the first stage. See Prentice *loc. cit.*

Prentice's process may include multiple second stages in multiple separate reaction zones. That is in fact preferred, and both working Examples include four reaction zones, with 95% conversion achieved in each Example in the fourth reaction zone. (See Col. 5, lines 20-23, "Preferably, the process should be carried out in a chain consisting of four 'continuous stirred-tank reactors' (CSTR) connected in series" and citations below.) This chain of reactors supports a primary means for maintaining a low level of latex conversion in the first reaction stage, namely, continuously withdrawing the polymerized latex from the first reaction zone at a rate equal to the rate of addition of the reagent mixture in the first stage. Col. 5, line 65 to Col. 6, line 9. The process in the first stage must be controlled in this manner to control the weight and composition of the polymer and to avoid undesired side reactions (i.e., formation of co-dimers of the conjugated diene and non-carboxylic comonomer).

By contrast, the instant application claims a process for producing a polymer (as defined on page 4, lines 8-13 of the specification) comprising (i) conveying mixtures of one or more monomers and one or more initiators to one or more hybrid reactors maintained at effective polymerization temperatures and sub-reflux gage pressures and causing polymerization of a portion of the monomers into a polymer, and (ii) conveying the hybrid reactor contents to one or more batch reactors maintained at effective polymerization temperatures and reflux gage pressures and polymerizing a remaining

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portion of the hybrid reactor monomers into the polymer. "Polymer" is defined in the specification, *loc. cit.*, as a homopolymer, various copolymers, a non-aqueous polymer dispersion, star polymer, microgel, or oligomer. Appellant's process requires at least one hybrid reactor monomer and at least one hybrid reactor initiator. In certain embodiments a polymerization medium is present; the medium is a liquid phase in which polymerization of monomers initiated by initiators takes place (specification, page 5, lines 3-14). The medium may be composed of one or more, or combinations of one or more, organic solvents, an aqueous medium, and a polymeric component. The optional aqueous medium can be water or a combination of water and water miscible solvents. Suitable solvents are listed in the specification at page 5, lines 15-19. The monomer mixture may or may not be miscible in the medium; miscibility or lack thereof will determine whether homogeneous or heterogeneous polymerization takes place if there is more than one variety of monomer. The process in its simplest embodiment is a two-stage process: in the first stage, monomers are partially polymerized under effective polymerization temperatures and sub-reflux gage pressures in the hybrid reactors and in the second stage, polymerization of the unreacted monomers from stage 1 is completed in the batch reactors under effective polymerization temperatures and reflux gage pressures. The second stage can be repeated, in as many steps as needed, to complete polymerization. In both stages, polymerization occurs at high temperatures.

The Examiner has asserted that Prentice "discloses the same steps, in the same process conditions, the same reactor and the high rate monomer conversion [as the application]" (Final Office Action of June 23, 2005, page 6, lines 3-4). The Advisory Opinion essentially reiterates the Examiner's position that Appellant has not succeeded in distinguishing the two stages in Prentice from the two stages of the claimed invention. There are, in fact, substantial differences in the steps and the reaction conditions. For example, Prentice carries out the first stage of partial polymerization at 71° C; the remaining steps (stage two and repetitions thereof) are carried out in the low to mid-80° C range (Example 1, Col. 7, lines 57, 59, 60, 63; Example 2, Col. 9, lines 10, 12-17). Claims 10 and 21 call for effective temperature ranges of hybrid and batch polymerization, respectively, of 80° C to 400° C (hybrid) and 80° C to 300° C (batch). The Examples of the

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application reflect these ranges for the hybrid (first stage) polymerization: Copolymer 1, page 25, lines 7-8 of the application, discloses a temperature of 187° C at sub-reflux and (page 25, lines 24-26), a polymerization temperature of 190° C was maintained. The same or similar elevated temperatures are disclosed in the other Examples of the application (for example, 190° C at sub-reflux for Copolymer 4 (page 30, lines 2-3); 175° C at sub-reflux for Copolymer 6 (page 32, line 30); 175° C for Macromonomer 1 (page 35, lines 29-30)). Second stage (batch) reaction temperatures are similarly higher in the Examples of the application versus those of Prentice: 157° C for Copolymer 2 (page 27, lines 14-15); 140° C for Copolymer 7 (page 34, lines 13-15). A review of the Examples in the application reveals that the lower temperature parameter (80° C) is the lowest temperature to which the polymerization mixtures are allowed to cool in the final segment of the residence time in the reactor.

There are several essential limitations, or elements, of the claimed invention not disclosed or taught by Prentice. Prentice does not disclose homopolymerization. Prentice does not disclose a first stage of polymerization, or co-polymerization, under sub-reflux gage pressures at effective polymerization temperatures to obtain a low molecular weight polymer without the use of chain transfer agents. Sub-reflux polymerization in stage 1 is an essential element of Appellant's invention, and this limitation is present in all pending claims. Moreover, Prentice teaches that temperature parameters are critical reactor conditions, while the present invention claims manipulations of sub-reflux or reflux gage pressures in conjunction with temperature as critical to maintaining suitable reaction conditions for achieving product having the desired structure and physical properties. Prentice teaches that the conversion to polymer in stage 1 is 3% to 12% with 5% to 10% preferred and with 5% to 7% disclosed in both working Examples (Col. 7, line 58 and Col. 9, line 11), while the invention claims first stage polymerization of 30% to 99% (see, *e.g.*, claims 12, 32).

As shown below, there are instances in the Office Action where the Examiner has cited purportedly anticipating references in Prentice that do not show all of the elements of the claim under review, often only very few of the elements, if that. Specific instances are discussed immediately below. The Examiner has not, therefore, met the requisite burden

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of proof for a finding that the invention disclosed in the application has been anticipated by Prentice.

For example, the Examiner cites Prentice, Col. 2, lines 63-65, for the proposition that functional or specialty monomers may be included in the polymerization process to effect certain polymerization and application properties. The excerpt goes on to recite functional groups: hydroxyl, amide, methylolamide, ester, amine, epoxy, aldehyde and halide. Typical specialty functional groups are set forth at Col. 3, lines 1-13. (The specialty functional components in Prentice are non-carboxylic comonomers that are polymerized in the presence of unsaturated carboxylic monomers in the first reaction zone to produce a partially polymerized latex monomer that is copolymerized with a conjugated diene primary monomer in the second and subsequent reaction zones.) The current application, page 17, lines 18-23, 27 recites functional acrylic monomers, but the examples cited in Prentice do not read on the Applicant's Markush group (claim 25, supported by the cited portion of the current application). (In the current application, the functional monomers are polymerized in the first stage reaction to form a partially or substantially polymerized non-latex product; the polymerization is completed in the second stage.) The invention in Prentice, therefore, is the pre-polymerization of the non-functional and acid functional monomers in order to tie up the non-functional monomer. Subsequently, this pre-polymer is polymerized with the conjugated diene. In this way, codimers of conjugated diene and the non-functional monomers are avoided. These are critical distinctions and illustrate the material differences in the essences of each invention. Prentice seeks to create very high molecular weight latex polymers while avoiding impurities such as 4-phenylcyclohexene (4-PCH) and undesired side reactions. The process of the present invention was conceived to produce very low molecular weight materials (in the M_n range of about 1000 to 20,000).

The Examiner appears to recognize that there are material differences between the ranges of monomer conversion between the present invention and Prentice, but then appears to argue that this is a distinction without a difference (Advisory Opinion, page 2, lines 15-21). The Examiner appears to be saying that the degree of conversion depends on process conditions. This is only partly so, and in any event, does not recognize the

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necessity for low conversion in Prentice and the desirability of high conversion in the current application. In Prentice, the conditions (temperature, pressure) as well as the other numerous components of the medium, also influence degree of conversion – and in Prentice, the desire is to keep the rate low in stage 1 to avoid introducing impurities into the medium and setting off undesired side reactions. Therefore, Prentice requires the additional step of continuously removing pre-polymerized latex product as reagent is added to the stage 1 reactor to keep the polymer concentration low. This step is neither required nor desired in the present invention: rather, a high degree of polymerization is desired, and obtained, and no polymer is withdrawn until the entire stage 1 process has been completed. In this sense also the two stages are entirely different.

Another of Appellant's examples, (meth)acrylonitrile, is not even given as a generic example (*viz.*, nitrile functional group) of a functional or specialty monomer in Prentice (compare the current application, page 17, lines 18-23, 27 and claim 25, with Prentice, Col. 2, line 63 to Col. 3, line 20). Col. 3, line 68 does indeed recite an "aqueous phase" but in an entirely different context, teaching that emulsion polymerization, especially of latexes, requires "many different nonpolymerizable components" (Col. 3, lines 63-64) and that water, a necessary component in Prentice and an optional one in the current application, can be used as a carrier for some of these necessary, nonpolymerizable, components, such as chelating agents, electrolytes, emulsifying agents, or surfactants and other ingredients (Col. 3, line 68 to Col. 4, line 3). The aqueous phase in the invention, alone or in combination with water miscible solvents and/or organic solvents and/or a polymeric component, acts as a solvent, in which monomers may or may not be miscible, thus contributing to a determination of whether homogeneous or heterogeneous polymerization will take place. Appellant would earnestly and respectfully submit that the words "the aqueous phase" as used in Prentice does not read on the aqueous medium as used, for example, in claims 3 and 5 of the invention.

While Prentice discloses a CSTR and Applicant specifies that the hybrid reactor is a CSTR (claim 9) and that the batch reactor is a CSTR (claim 20), this limitation is not essential to, and is not recited at all in, claim 1. Prentice discloses temperature and pressure parameters, but does not disclose essential limitations that the first stage

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polymerization is achieved under sub-reflux conditions and the second stage under reflux conditions. Nor are the temperature ranges in Prentice directly comparable to the claimed ranges of the invention, because the solutions used in each are so different, and gage pressures can vary significantly. In Prentice, polymerization is not completed until after the third zone (preferably about 80% to about 90% achieved), so it can be deduced that up to 99% polymerization in Prentice will not be achieved until fourth zone, or later, polymerization. The claimed preferred embodiment of the instant invention would achieve up to 99% polymerization in the first stage of polymerization (claim 12). Prentice discloses that first stage polymerization does not exceed 12%, whereas in the instant invention, first stage polymerization is at least 30% (claim 12, also claim 32).

Finally, Appellant submits that "sub-reflux" and "reflux" conditions are not inherent in Prentice for the reasons stated by the Examiner. Though there is a two-stage process, CSTR tanks can be used both in the invention and in Prentice, and a high rate of monomer conversion can be achieved in both the invention and the reference, the differences in the methods, objects and goals of both inventions are too different for inherency. As noted above, Prentice requires a highly complex mixture of three polymerizable moieties (non-carboxylic comonomer, unsaturated carboxylic acid monomer, and conjugated diene), water, chain transfer agents, electrolytes, chelating agents, emulsifiers, and initiators, as well as solvents, (Col. 1, line 63 to Col. 2, line 4, and, e.g., Example 1). The invention requires at least one monomer and at least one initiator, with at least one solvent component preferred. It would be very difficult, even for one skilled in the art, to compare the reaction conditions of Prentice's complex solutions to produce a latex composition and the conditions required to prepare a homopolymer or copolymer of the invention. That carboxylated latex compositions with reduced levels of impurity can be produced under conditions disclosed in Prentice does not inherently lead a skilled polymer engineer to the conclusion that very different polymers being reacted in different solutions, without chain transfer agents, emulsifiers and catalysts, would be produced in high yield and purity under purportedly similar conditions.

In conclusion, a finding of anticipation under 35 U.S.C. 102(b), based upon a patent or printed publication, requires that the reference disclose all limitations of the

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claimed invention. This statute, as it pertains to a patent or printed publication, is a loss of right provision. In short, if the inventor or a third party (as is the case here) patents or publishes *the subject invention* in this or a foreign country more than one year prior to the effective U.S. filing date of the patent application under review, the right to receive a patent for that particular *invention* is forfeited. Note that the statute sets forth that "A person shall be entitled to a patent unless – (b) *the invention* was patented or described in a printed publication" [emphasis added]. This necessarily requires a comparison of the elements of the claims of the invention against the cited reference. For any claim under review to be anticipated under §102(b) by a prior patent or publication, each element of each claim under review must be identically shown in a single reference. These elements must also be arranged as in the claim under review. *In re Bond*, 15 USPQ2d 1566, 1567 (CAFC 1990). In addition, for Prentice to anticipate the present invention, Prentice must enable a person of ordinary skill in the art to produce the claimed invention. *In re Paulsen*, 31 USPQ2d 1671 (CAFC 1994). The skilled artisan must be able to produce the claimed invention without undue experimentation. *In re Wands*, 8 USPQ2d 1400 (CAFC 1988). What constitutes undue experimentation in a given case requires the application of a standard of reasonableness, having due regard for the invention and the state of the art.

Prentice teaches a process in a relatively narrow, though important area of technology. Prentice teaches the production of high molecular weight latex compositions by reacting a narrow range of reactants in a highly controlled medium, under controlled conditions, to avoid by-products and side reactions. Specifically, Prentice uses the first (pre-polymerization) stage of his process to react non-functional and acid functional monomers to "tie up" the non-functional monomer and then subsequently co-polymerize this pre-polymer with a conjugated diene. The lack of conversion in stage 1 of Prentice is essential to the necessary control of copolymer composition and molecular weight distribution, as well as control of by-products and side reactions. The first stage has a continuous aspect to it, in that polymerized latex is withdrawn and conveyed to a second stage reactor to keep pre-polymerization *below* 12% conversion. The object is to make high molecular weight latex compositions. In the present invention, stage polymerization is applied to make low molecular weight polymers by modulating temperatures and

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pressures to keep temperatures elevated with pressures within safe ranges. One would not seek to achieve low conversion from an industrial reactor if there were not a compromising condition, and it is not an object or a result of the present invention to maintain first stage polymerization *below* any designated benchmark level. The compromising conditions in Prentice have been noted. In the present invention, high conversions can be achieved under elevated temperature and pressure conditions and a residence time to permit homogenizing copolymer characteristics to achieve a uniform molecular weight distribution at relatively low molecular weight.

As noted in detail above, the temperature, pressure and reagent conditions are quite different between Prentice and the present invention. Taken as a whole, Prentice does not enable the present invention. Prentice deals solely with emulsion polymerization at lower temperatures. Prentice does not teach or otherwise disclose how to operate safely under pressure in making solution acrylics at temperatures much higher than emulsions and in such a way that molecular weight distribution is controlled at moderate to low magnitudes. Emulsion polymerization is heterogeneous polymerization and involves transfer between phases. The present invention is directed primarily to homogeneous polymerization in solution.

For all of the reasons stated above, Appellant respectfully submits that Prentice does not anticipate the present invention.

**II. Whether Claims 1-46 Are Unpatentable Under
35 U.S.C. §103(a) Over Berge in View of Prentice.**

Claims 1-46 stand rejected as unpatentable under 35 U.S.C. §103(a) over Berge in view of Prentice.

Appellant reiterates all remarks and arguments in traverse of Prentice presented above.

Berge is directed to a method for producing macromonomers, containing at least one reactive terminal functional group, that are useful as precursors for polymers of varying three-dimensional structures, such as block polymers, branched polymers, non-aqueous dispersion polymers, star polymers, and ladder polymers (Col. 7, lines 62-65). Principal objects of the Berge invention were to provide a method of polymerization to

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obtain macromonomers with an olefinic polymerizable end group using ω -unsaturated oligomer as a chain transfer agent, to control molecular weight of the macromonomer so produced, to provide an effective process at lower temperatures, reduced initiator costs, and less color in the product (Col. 2, lines 21-25). The overall object was to provide an efficient method for producing macromonomers that would be useful in producing a variety of polymers having applications that would be apparent to skilled practitioners in the art through production methods not disclosed or claimed in Berge. The primary object of Prentice was to produce carboxylated latex compositions, especially carboxylated butadiene-styrene latexes, with reduced presence of the contaminant 4-phenylcyclohexene (4-PCH) and possessing desirable properties of film stiffness and stress-strain relationship. Prentice deals solely with emulsion polymerization at lower temperatures. Emulsion polymerization is heterogeneous polymerization and is directed to transfer between phases.

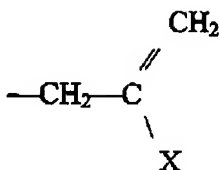
Among the principal objects of the present invention are: to provide processes for producing polymers at reduced hybrid reactor gage pressures, for enhancing the safety of the manufacturing process and to produce relatively low molecular weight products without using chain transfer agents and in the presence of relatively low initiator concentrations. Eliminating chain transfer agents is both economical and greatly reduces the presence of impurities in the product and undesirable by-products. Reducing initiator concentrations is also economical. In general, reduced gage pressures limit the dispersity of polymerization initiators, leading to lower yields of product. The Applicant has discovered processes in which gage pressure in stage 1 can be reduced, with concomitant reduction in initiator concentration, without sacrificing yield, while allowing the chemist or engineer to control molecular weight without having to rely upon a chain transfer agent. (Please note the exception, based on claims 34-35, cited above.)

The Examiner relies primarily upon Berge in entering this rejection. While it is generally true that in Berge and in the present application polymerization can be carried out in a CSTR and in the presence of a polymerization medium, these and other general similarities do not teach or enable the different processes and methods employed for different objects and goals. The chain transfer agents in Berge are actually oligomers characterized by an end group represented by the general formula,

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wherein X is as defined (Col. 5, lines 16-24). Preferred examples are shown in Col. 6, lines 1-45. While a metal chelate, such as a cobalt complex, may be used as a catalyst in the production of the oligomeric chain transfer agents of Berge, Col. 10, lines 1-28, the chain transfer agents of Berge neither read on those of the invention nor suggest them. The transfer agents recited in claim 35 of the invention are cobaltates.

While the field of claims 33-45 of the invention (a process for producing a graft copolymer) overlap with part of the field of Berge (a process for preparing a macromonomer that has utility with other components in the production of block polymers, branched polymers, non-aqueous dispersion polymers, star polymers and ladder polymers, see Berge, Col. 7, lines 62-65), there are substantial differences in the goals and objects of the two. Berge requires an oligomeric chain transfer agent to produce a macromonomer having an olefinic terminal functional group, where the macromonomers are further polymerizable into a number of diverse polymers having cited uses and applications. The invention provides a two stage process for producing a high yield of polymer product. And although it is entirely possible that a skilled practitioner in the field of the invention would be aware of Berge, it is also true that such a practitioner would know that Berge does not teach or suggest how to make a polymeric product from the macromonomers disclosed. In addition, it is highly unlikely that a skilled practitioner in the field of the invention would know of Prentice as a reference, since the fields are entirely different. Prentice relates to very specific processes for producing specific latex composition products through emulsion polymerization techniques that are well known in the synthetic latex art. Even if a practitioner of the art of the invention became aware of Prentice, there would be no motivation to combine Prentice with Berge to achieve the goals and objects of the invention.

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The Examples in Berge teach away from the processes of the present invention in various respects. Examples 1-3 of Berge teach away from the processes of the present application in that they relate to low temperature (80°C) synthesis of an oligomer, rather than high temperature synthesis of a polymer. (As noted below, most of the Examples in Berge disclose low temperature processes.) Examples 4-5 of Berge also relate to oligomer synthesis, in these instances with a cobalt complex chain transfer agent, rather than polymer synthesis without such chain transfer catalyst. Examples 6-10 relate to macromonomer synthesis from an oligomeric chain transfer agent, such as those synthesized in Examples 1-5. These are all three-part processes in which oligomers or monomers as in Example 8 are introduced in Part I, generally with a solvent and optional initiator, followed by solvent and initiator in Part II, and vinyl monomers and optional oligomers in Part III; all employ an end-functional chain transfer agent. The Parts were added as three separate feeds to a single reactor vessel. The remaining Examples 11-16 relate to syntheses of a pure trimer or macromonomers using an end-functional oligomeric chain transfer catalyst. The object is to produce oligomers or macromonomers with particular end-group functionalities, and not copolymers of low molecular weight as in the present application. Most of the Examples in Berge teach low temperature (80°C) processes (though Examples 4 and 5 teach reflux temperatures – without specificity – in the polymerization stage); none teach proper pressure controls or the interplay between pressure and temperature to achieve high temperature polymerization at sub-reflux in stage 1 to achieve high degrees of polymerization of relatively low molecular weight polymer products. Accordingly, there would have been no motivation for the inventors of the present invention to modify Berge to achieve their results. In fact, those results would not have been possible using only obvious modifications to Berge.

The Examiner then asserts that it would have been obvious to one skilled in the art to combine Prentice with Berge to add a second stage of polymerization to complete the synthesis at high degrees of polymerization. Prentice discloses a second stage in which conjugated diene is copolymerized with unreacted non-carboxylic comonomer in the partially polymerized latex. The two working Examples in Prentice disclose that the second and subsequent reaction zones are maintained at 84°C to 85°C or 86°C to complete

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the polymerization of the latex product (Col. 7, lines 58-64; Col. 9, lines 11-14). In the current application, by contrast, the second stage of polymerization uses the hybrid reactor contents conveyed to the batch reactor and is there maintained at reflux temperature and pressure until polymerization is completed. There is no addition of a conjugated diene and no partially polymerized latex as part of the polymerization medium. The copolymer Examples 1-7 of the present application call for reflux temperatures in stage 2 of from 140°C to 157°C.

It appears that the second stage in Prentice operates under comparable conditions as the first stage, unlike the present invention (sub-reflux vs. reflux conditions). Given the very narrow range of the field of Prentice, emulsion polymerization for the production of latex, it is questionable whether Prentice is even analogous as prior art against the invention. Appellants submit that it is at least questionable whether Prentice is analogous art to the instant application. There is no reason a chemist making polyacrylics would combine Berge with Prentice. And, it is to be noted, it is counter-intuitive to achieve a high conversion of monomer to polymer under sub-reflux conditions with relatively low initiator concentration as is accomplished in the first stage of the present invention. Nothing of the sort is disclosed, suggested or adumbrated in Prentice.

For all of the foregoing reasons, it would not have been possible to achieve the results of the present invention by modifying Berge. There would have been no motivation for, or reasonable expectation of success in, combining Prentice with Berge. Accordingly, the invention is not obvious over Berge in view of Prentice.

The Board of Appeals is respectfully requested to remand this application to the Examiner with a direction to allow the claims, or in the alternative to reopen prosecution so that claim amendments may be entered to place the claims in allowable form.

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8. CLAIMS APPENDIX

1. A process for producing a polymer comprising:

conveying hybrid reactor mixtures comprising one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors maintained at effective hybrid polymerization temperatures and sub-reflux polymerization gage pressures to cause polymerization of a portion of said hybrid reactor monomers into said polymer; and

conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux polymerization pressures to cause polymerization of a remaining portion of said hybrid reactor monomers into said polymer.

2. The process of claim 1 wherein said hybrid reactor mixture comprises a polymerization medium.

3. The process of claim 2 wherein said polymerization medium comprises one or more organic solvents, an aqueous medium, or a polymeric component.

4. The process of claim 3 wherein said organic solvent is selected from the group consisting of acetone, methyl amyl ketone, methyl ethyl ketone, an aromatic solvent blend, xylene, toluene, ethyl acetate, n-butyl acetate, t-butyl acetate, butanol, glycol ether, and combination thereof.

5. The process of claim 3 wherein said aqueous medium comprises water, or an aqueous solution of water and miscible solvent.

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6. The process of claim 3 wherein said polymeric component comprises a polyester, acrylic polymer, or a mixture thereof solvated or dispersed in one or more said organic solvents or said aqueous medium.
7. The process of claim 1 further comprising conveying a polymerization medium to said hybrid reactors before said hybrid reactor mixtures are conveyed to said hybrid reactors.
8. The process of claim 1 wherein an excess portion of said hybrid reactor contents is conveyed to said batch reactors once said hybrid reactors are filled to preset levels.
9. The process of claim 1 wherein said hybrid reactors are stirred tank reactors.
10. The process of claim 1 wherein said hybrid polymerization temperatures range from 80°C to 400°C.
11. The process of claim 1 wherein said sub-reflux polymerization gage pressures in said hybrid reactors range from 0 to 2.76 MPa (0 to 400 psig).
12. The process of claim 1 wherein said portion of said monomers polymerized in said hybrid reactors ranges from 30 weight percent to 99 weight percent, all based on the total amount of monomers conveyed to said hybrid reactors.
13. The process of claim 1 comprising conveying inert gas in vapor space in said hybrid reactors.
14. The process of claim 13 wherein said inert gas is nitrogen, argon, carbon dioxide or a mixture thereof.

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15. The process of claim 1 wherein batch reactor contents comprise a polymerization medium.

16. The process of claim 15 wherein said polymerization medium comprises one or more organic solvents, or an aqueous medium.

17. The process of claim 1 further comprising conveying one or more said initiators to said batch reactors.

18. The process of claim 1 or 17 further comprising conveying one or more said monomers to said batch reactors.

19. The process of claim 1 further comprising conveying a polymerization medium to said batch reactors before said hybrid reactor contents are conveyed to said batch reactors.

20. The process of claim 1 wherein said batch reactors are stirred tank reactors.

21. The process of claim 1 wherein said batch polymerization temperatures range from 80°C to 300°C.

22. The process of claim 1 wherein said reflux polymerization pressures in said batch reactors are at an atmospheric pressure.

23. The process of claim 1 comprising conveying inert gas in vapor space in said batch reactors.

24. The process of claim 1 wherein a solution of said hybrid reactor initiators in a polymerization medium is conveyed to said hybrid reactors.

25. The process of claim 1 wherein said hybrid reactor monomers are selected from the group consisting of (meth)acrylate monomers, functional (meth)acrylic

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monomers, acid monomers, nitrile monomers, styrene, styrenic monomers, amide monomers, silyl monomers, vinyl monomers, and a combination thereof.

26. The process of claim 1 wherein said initiators comprise redox initiators, thermal initiators, photochemical initiators, or a combination thereof.

27. The process of claim 1 further comprising conveying a portion or all of said hybrid reactors contents to said batch reactors when preset unsafe hybrid reactor pressures are reached.

28. The process of claim 2 further comprising rinsing said hybrid reactors with a chaser portion of the polymerization medium after all of the hybrid reactor contents had been conveyed to batch reactors; and

conveying said chaser portion to said batch reactors.

29. The process of claim 1 wherein said polymer is an acrylic polymer, a blend of an acrylic polymer and polyester, microgel, homopolymer, copolymer, block copolymer, graft copolymer, comb copolymer, branched copolymer, branch-upon-branch copolymer, non-aqueous polymer dispersion, star polymer, oligomer, and a ladder copolymer.

30. A polymer made by the process of claim 1 or 29.

31. A coating composition comprising a polymer made by the process of claim 1 or 29.

32. A process for producing a polymer comprising:
conveying a hybrid reactor mixture comprising one or more hybrid reactor monomers and one or more hybrid reactor initiators to a hybrid reactor maintained at an

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effective hybrid polymerization temperature and sub-reflux polymerization pressure to cause polymerization of substantial amount of said hybrid reactor monomers into said polymer; and

conveying hybrid reactor contents to a batch reactor maintained at an effective batch polymerization temperature and reflux polymerization pressure to cause polymerization of remaining amount of said hybrid reactor monomers into said polymer.

33. A process for producing a graft copolymer comprising:

conveying hybrid reactor mixtures comprising one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors maintained at effective hybrid polymerization temperatures and sub-reflux polymerization gage pressures to cause polymerization of said hybrid monomers into macromonomers;

conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux polymerization pressures; and

conveying batch reactor mixtures comprising one or more batch reactor monomers and one or more batch reactor initiators to cause polymerization of said batch reactor monomers into a backbone of said graft copolymer having said macromonomers grafted onto said backbones.

34. The process of claim 33 comprising conveying on or more chain transfer catalysts to provide said macromonomers with an unsaturated terminal group.

35. The process of claim 34 wherein said chain transfer catalyst is diaquabis(borondifluorodimethylglyoximato)cobaltate(II),

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diaquabis(borondifluorodiphenylglyoximate)cobaltate (II), pentacyanocobaltate (II), or a combination thereof.

36. The process of claim 33 wherein said hybrid reactor contents and said batch reactor mixtures are conveyed simultaneously to said batch reactors or said hybrid reactor contents are conveyed to said batch reactors after said conveying of a portion or all of said batch reactor monomers to said batch reactors.

37. The process of claim 36 wherein a portion or all of said batch reactor initiators is conveyed simultaneously with said batch reactor monomers or with said hybrid reactor contents to said batch reactors.

38. The process of claim 36 further comprising conveying a polymerization medium to said hybrid reactors, said batch reactors; or to said hybrid and batch reactors before conveying said hybrid reaction mixtures to said hybrid reactors.

39. The process of claim 36 further comprising conveying a polymerization medium to said hybrid reactors before conveying said hybrid reaction mixtures to said hybrid reactors.

40. The process of claim 36 further comprising conveying a polymerization medium to said batch reactors before conveying said hybrid reactor contents to said batch reactors.

41. The process of claim 36 further comprising conveying a polymerization medium to said batch reactors before conveying said batch reactor mixtures to said batch reactors.

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42. The process of claim 36 further comprising conveying a polymerization medium to said batch reactors before conveying said batch reactor mixtures and said hybrid reactors contents to said batch reactors.

43. The process claim 36, 37, 38, 39, 40, 41 or 42 wherein a solution of said hybrid reactor initiators in a portion of said polymerization medium is conveyed to said hybrid reactors.

44. The process claim 36, 37, 38, 39, 40, 41 or 42 wherein a solution of said batch reactor initiators in a portion of said polymerization medium is conveyed to said batch reactors.

45. The process claim 36, 37, 38, 39, 40, 41 or 42 wherein a solution of said hybrid reactor initiators in a portion of said polymerization medium is conveyed to said hybrid reactors; and a solution of said batch reactor initiators in another portion of said polymerization medium is conveyed to said batch reactors.

46. A process for producing a polymer blend comprising:
conveying hybrid reactor mixtures comprising one or more hybrid reactor monomers and one or more hybrid reactor initiators to one or more hybrid reactors maintained at effective hybrid polymerization temperatures and sub-reflux polymerization gage pressures to cause polymerization of said hybrid monomers into a hybrid reactor polymer;

conveying hybrid reactor contents to one or more batch reactors maintained at effective batch polymerization temperatures and reflux pressures; and

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conveying batch reactor mixtures comprising one or more batch reactor monomers and one or more batch reactor initiators to cause polymerization of said batch reactor monomers into a reactor polymer to form said polymer blend.

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9. EVIDENCE APPENDIX

None.

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10. RELATED PROCEEDINGS APPENDIX

None.